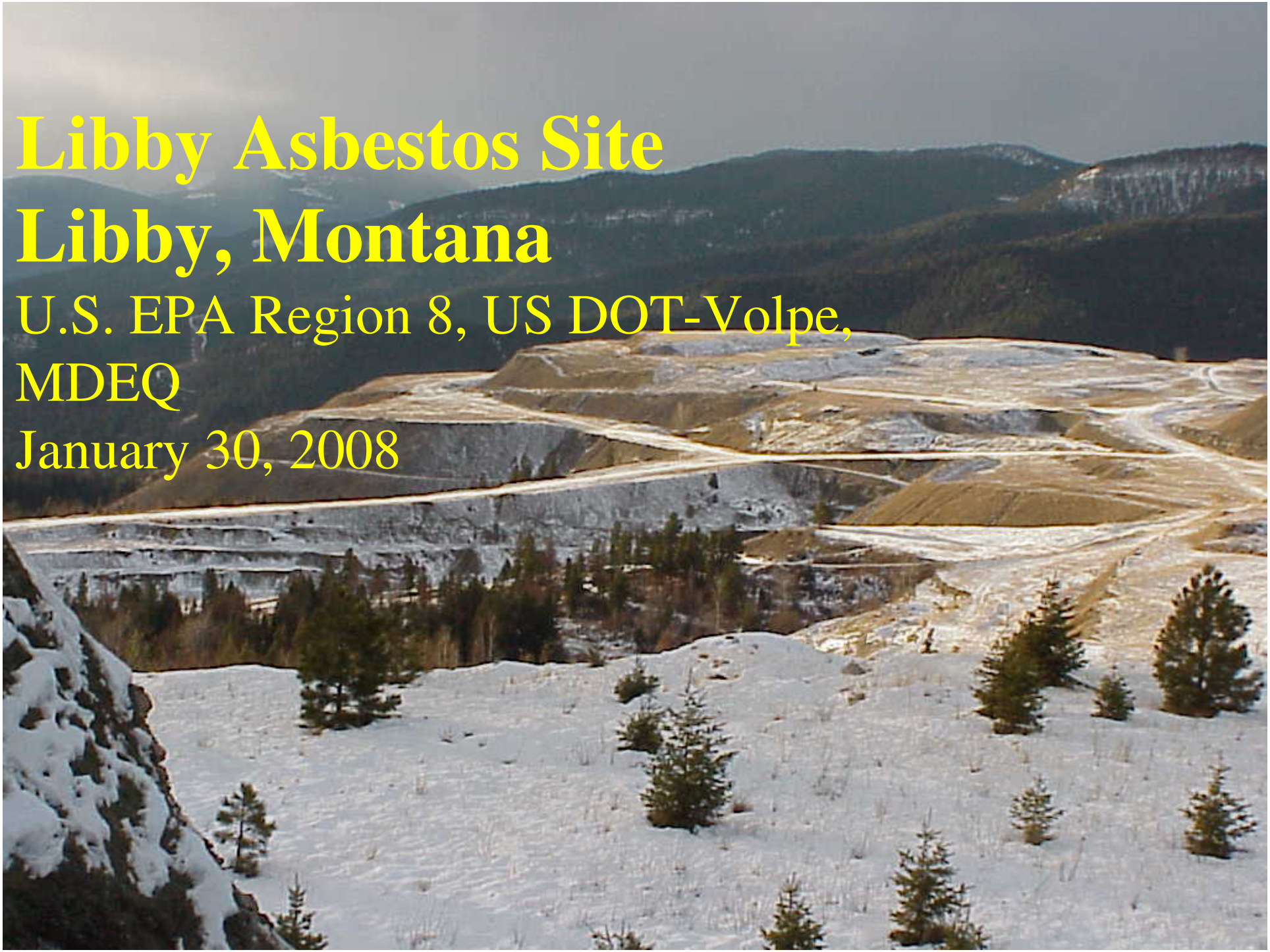

Libby Asbestos Site
Libby, Montana
U.S. EPA Region 8, US DOT-Volpe,
MDEQ
January 30, 2008

Presentation Overview

- Libby Asbestos Summary
- Contamination in Libby
- Health Effects
- Current Situation
- Current Issues
- Proposed Approach

Two General Types of Asbestos

- **Serpentine Asbestos** (chrysotile)
  - Most commonly used.
  - Snake-like structure.
- **Amphibole Asbestos** (hundreds of fiber types)
  - Few commercial uses
  - Straight, spear-like structure.
  - Most literature considers more toxic.

Asbestos Mineral Types

Classic Regulated Forms (6)

Commercial Designations

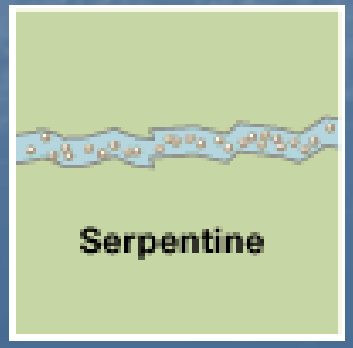
- **Serpentine**
  - Chrysotile

Comprises >90% of the asbestos used in products

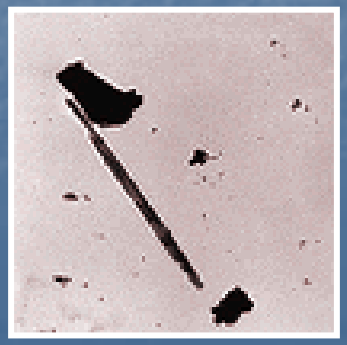
- **Amphibole**
  - Amosite
  - Crocidolite
  - Anthophyllite
  - Actinolite
  - Tremolite

Libby

Curly



Straight



Libby Amphibole (LA)

Libby Amphibole Composition

Winchite 85%

Richterite 10%

Tremolite 5%

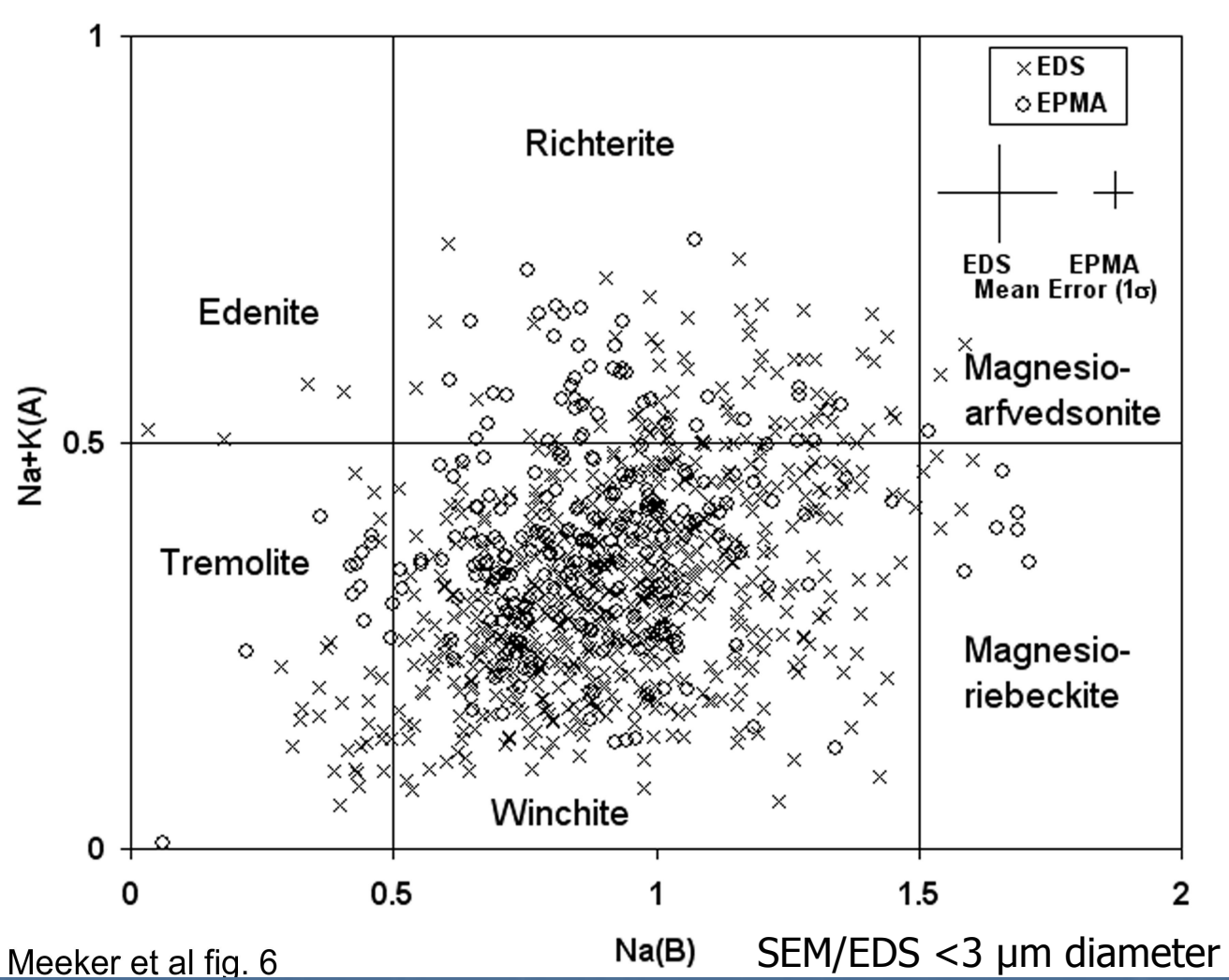
Classification Varies

Mineralogists

versus

Regulatory/Commercial

Based on the classification criteria of Leake et al. (1997).



Meeker et al fig. 6

SEM/EDS <3 µm diameter

Meeker et al. (2003). The composition and morphology of amphiboles from the Rainy Creek complex, near Libby, Montana. American Mineralogist.

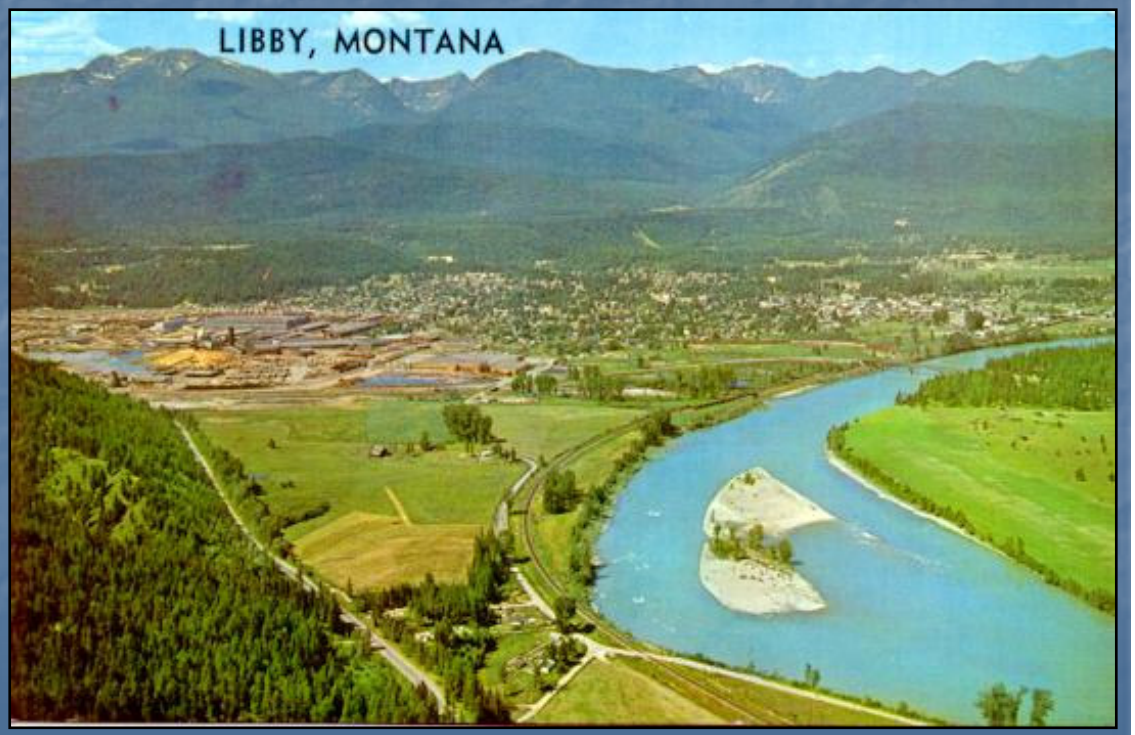
Asbestos Health Effects

- **Non-Cancer Fibrosis/Scarring** (latency >10 yrs)
  - Asbestosis – scarring of the air sacs
  - Pleural Fibrosis – scarring of lining around the lung

- **Cancer** (latency 20-40 yrs)
  - Lung Cancer
    - Increased risk of all lung cancer types, especially with smoking
  - Mesothelioma
    - Rapidly fatal cancer of the lining around the lungs & abdomen
    - Virtually all cases associated with asbestos exposure
    - Not affected by smoking
  - Other Cancers
    - Gastrointestinal & laryngeal

Libby, Montana

- Located in northwest Montana
- Area population: 12,000 (City 2,900)
- Area homes: 2,000 (400 City Homes)



Zonolite Mine

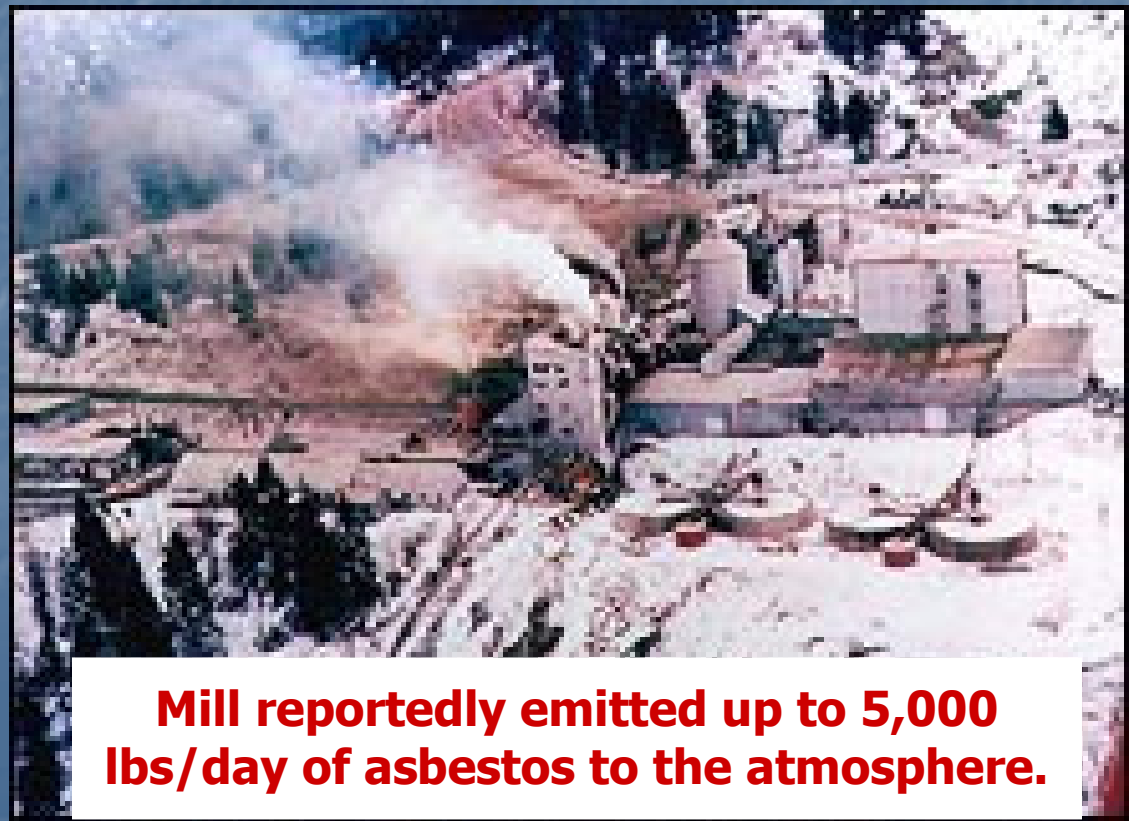
- Vermiculite mine operated 1920 -1990
- Produced up to 80% of world's vermiculite
- WR Grace bought in 1963 & closed in 1991 (>> 5 million tons)
- Typically 150-200 working at mine & facilities
  - (>1800 workers employed in total)

WORKER ASBESTOS EXPOSURES

Earlier up to 130 f/cc depending on job;

reduced later

(OSHA PEL 0.1 f/cc)

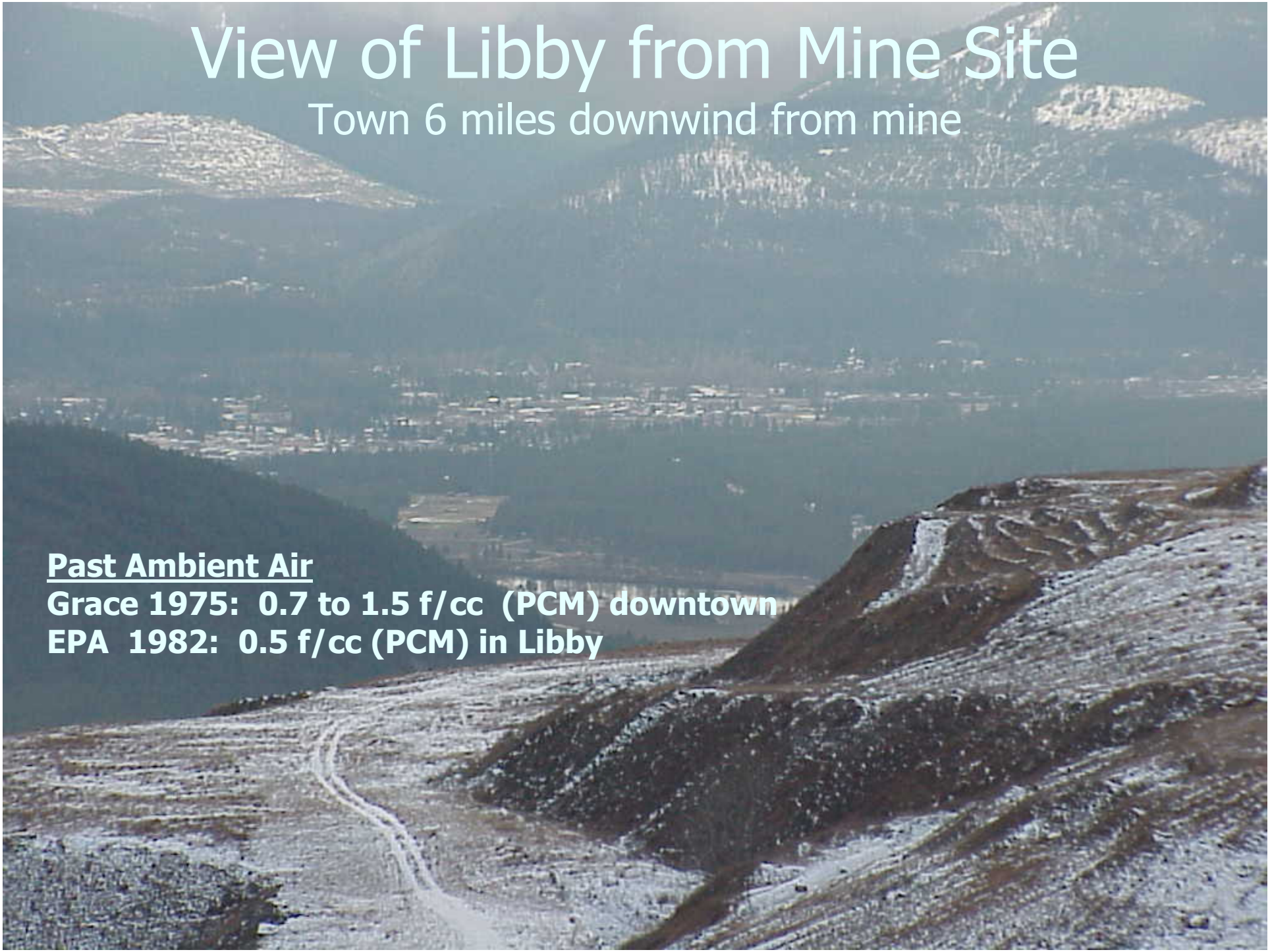


Mill reportedly emitted up to 5,000 lbs/day of asbestos to the atmosphere.


Libby Vermiculite Mine
Mine
Tailings Pile

View of Libby from Mine Site

Town 6 miles downwind from mine



<u>Past Ambient Air</u>
Grace 1975: 0.7 to 1.5 f/cc (PCM) downtown
EPA 1982: 0.5 f/cc (PCM) in Libby

1928 USGS report described the mine as an amphibole deposit contaminated by biotite (vermiculite).

Vermiculite Ore

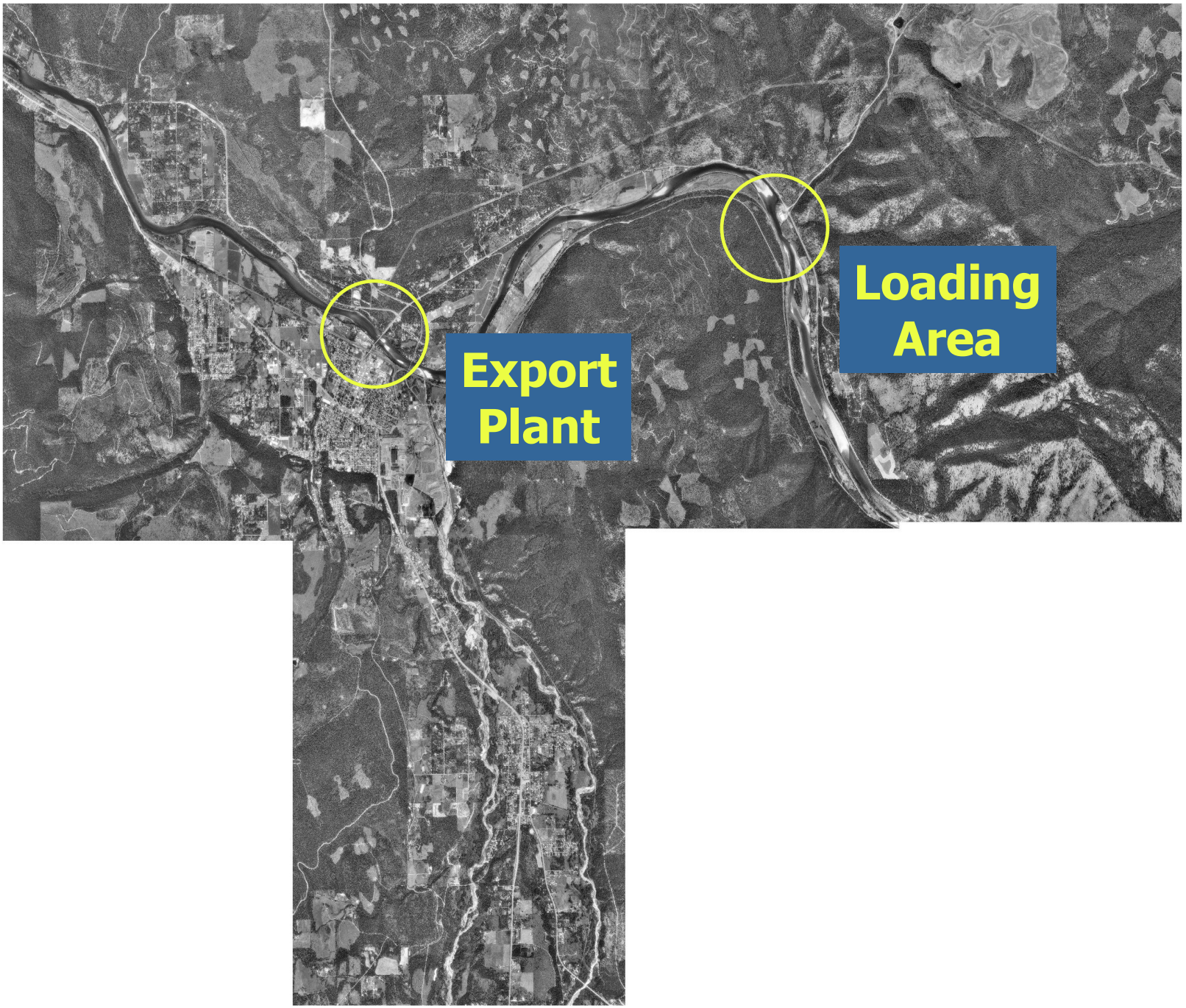
Libby Amphibole (LA)

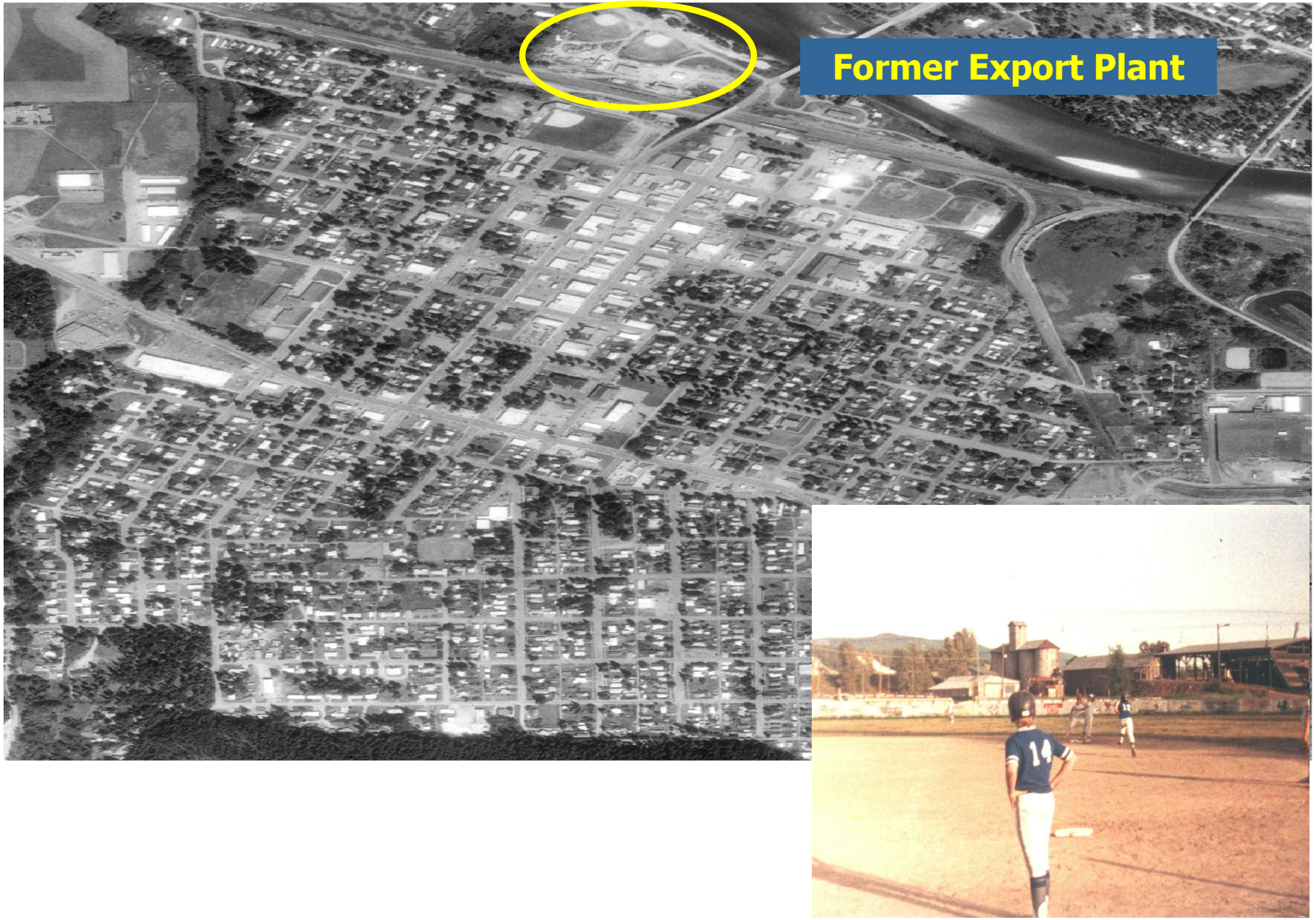
Vermiculite Mining
Zonolite Mine

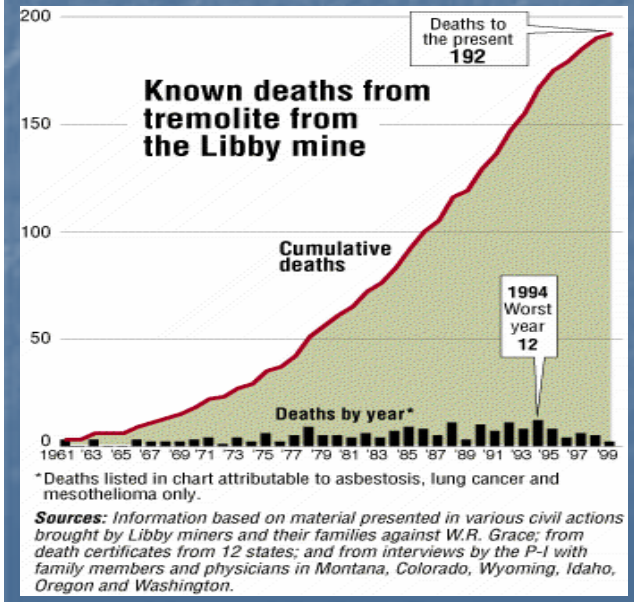
- Raw ore surface mined (up to 100% LA)
- LA in all vermiculite ore mined

Vermiculite

Raw Asbestos Ore


Export Plant
Loading Area


Former Export Plant



seattle P-I.com Special Reports

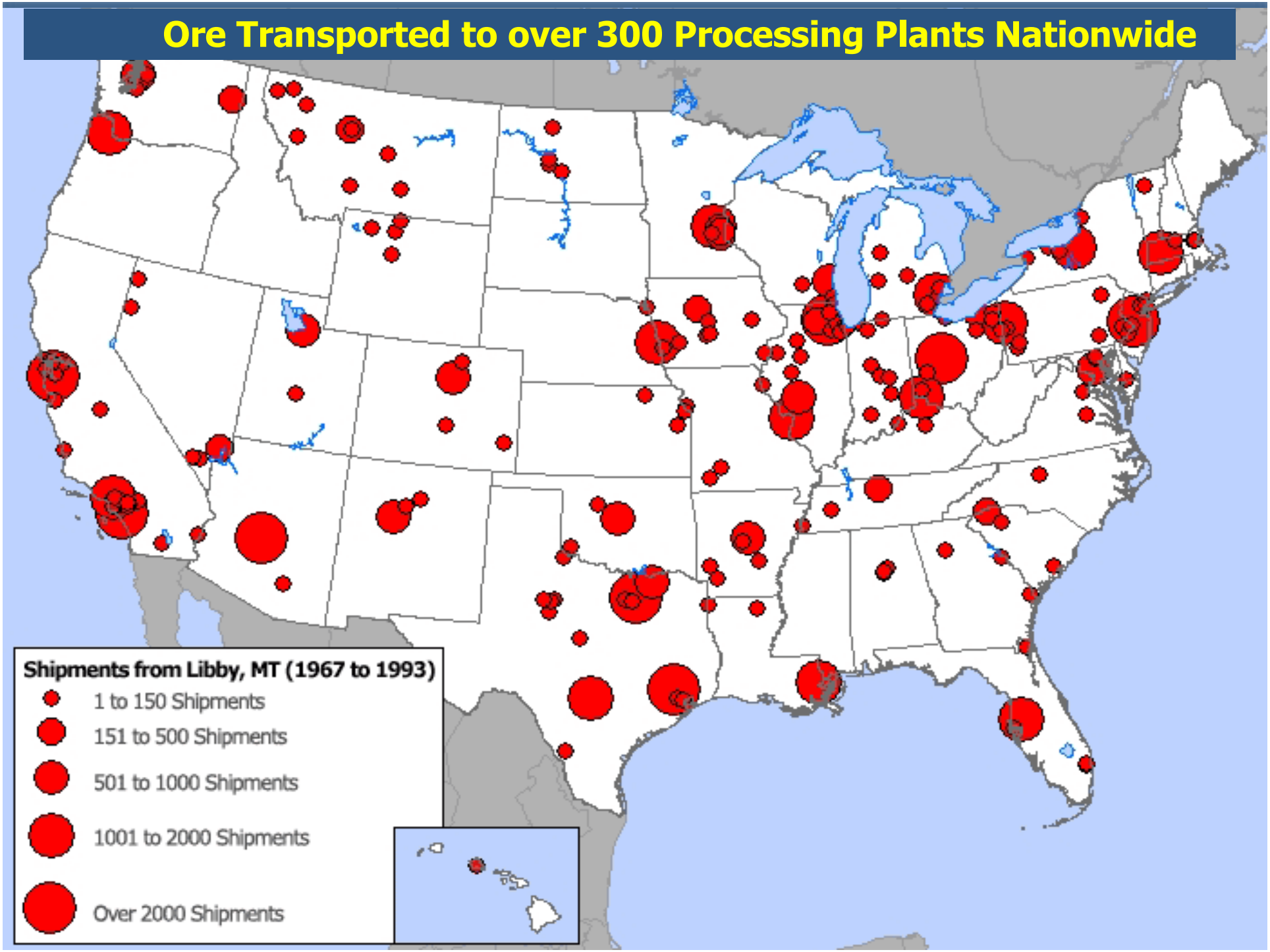
By ANDREW SCHNEIDER
SEATTLE POST-INTELLIGENCER SENIOR NATIONAL CORRESPONDENT

Uncivil Action: A town left to die

Tiny Libby, Mont., depended for years on the jobs at a vermiculite mine. But the mine is closed now, and a P-I investigation shows the town is paying a tragic price for those jobs. Hundreds of former miners, their wives and children, and other townspeople have either died or been diagnosed with fatal illness from asbestos the mine released into the air. No one stepped in to stop the dying. Now the town wonders when it will end, and if the town's children are still at risk.

"I want the people of Libby to know that we take very seriously these threats to their health and we are going to bring to bear the resources of EPA to solve the problem and prevent further harm," Yellowtail said.

Ore Transported to over 300 Processing Plants Nationwide



Historical Libby-related Health Data
Occupational

- **Libby Site**
  - Amandus (NIOSH; 1987) & McDonald Studies (1986)
    - Mortality: Increased risk asbestosis & lung cancer
    - Morbidity: Increased interstitial & pleural disease (x-rays)
    - McDonald Update (2003): Risk of mesothelioma (4.2%) in Libby miners, 10x that of chrysotile miners in Quebec; similar to crocidolite miners.
  - Grace Records: **1980: X-rays: 5+ yrs >35%; 10+ yrs >45%; 20+ yrs >60%**

- **Other Sites Processing Libby Vermiculite**
  - Lockey et al. (1984): OM Scott, Ohio: CXR abnormalities in 5% (n=513) of workers, pleural effusions, symptoms
    - Lockey Follow-up (2005): 26% Pleural abnormalities in same cohort
  - Wright et al. (2002): Case-report - 65 year-old dies of progressive asbestosis; only reported exposures 2 summers at ages 18 & 19 in California processing facility

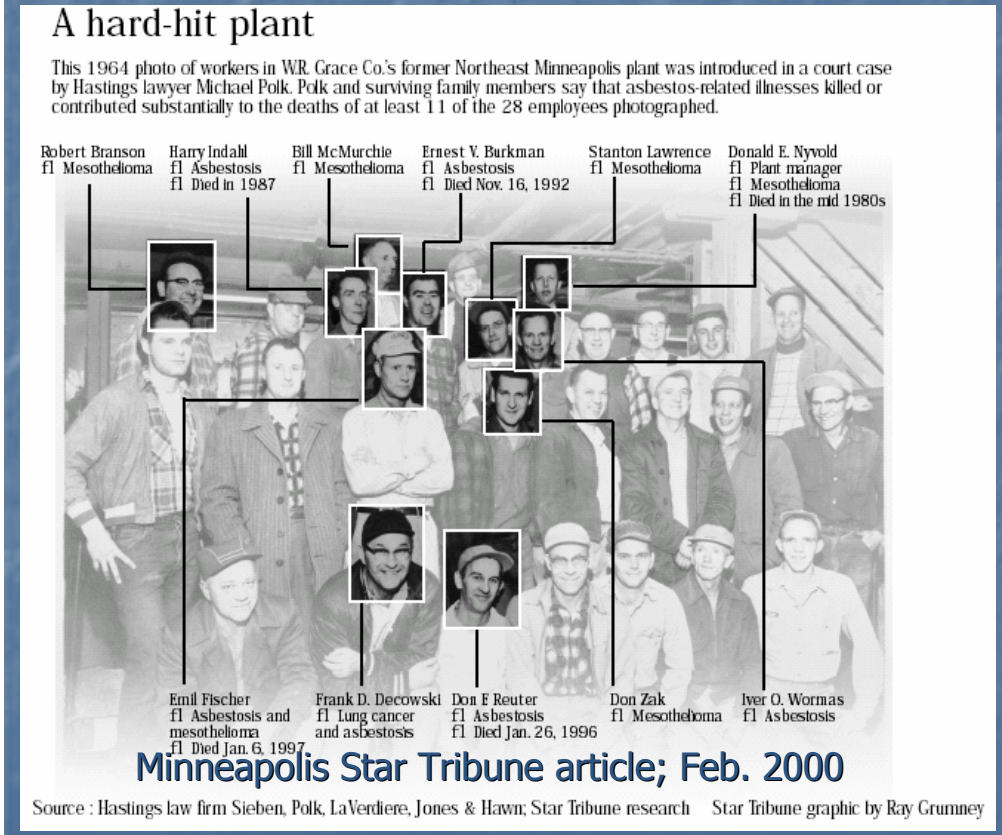
E1

Libby Sisters

>300 US Vermiculite Processors

Minneapolis major clean-up

- > 1600 properties evaluated
- > 250 properties remediated



•Srebro SH, Roggli VL (1994). Asbestos-related disease associated with exposure to asbestiform tremolite. Am J Ind Med.

Slide 20

E1 Justin and Tim Jorgensen, playing in the waste rock piles outside of the B.F. Nelson exfoliating plant in Minneapolis. Their father, Harris, died of mesothelioma on June 22, 1991 at age 44. His only known source of asbestos exposure was playing in these waste rock piles at the Nelson plant as a child.

EPA, 3/25/2004

Medical Investigations

- Funded by EPA, led by PHS and ATSDR
- Three pronged effort
  - Mortality Studies
  - Case-Series
  - Medical Screening

Libby Health Data Since 1999
Mortality Studies

- **NIOSH**:*
  - County asbestosis rate ~ 40X US rate;
  - Age-adjusted rate 1988-1997 was highest in the US

- **ATSDR**: (20 year study period: 1979 – 1998)
  - Increased risk compared to MT & US populations
    - Asbestosis: 40-80x higher
    - Lung Cancer: 20-30% higher
    - Mesothelioma: marked increase (rate not quantifiable)
      - Observed 3/~ 2500 (deaths outside county not counted)
      - Expected: typically estimated <10/million
      - >30 cases reported among current and former Libby residents

* **Evaluation NCHS data per R. Castellan, MD; NIOSH/DRDS**

Libby Medical Screening
Funded by EPA, led by ATSDR & PHS

- >7300 individuals screened
- World's largest single point asbestos screening
- Basic screening consisted of
  - Three view chest x-rays
  - Basic spirometry
  - Extensive exposure questionnaire

Prevalence of Pleural Abnormalities
Asbestos-Related X-Ray Changes

- **Libby Site: 18% Overall**
  - 5% with no apparent exposure
  - 57% among former workers
  - 24% among participants with 6+ reported pathways
  - >75% of those with abnormalities are non-workers, non-family members

- **Other US Studies:**
  - 0.2%: 1422 blue-collar workers in North Carolina (Castellan 1985)
  - 0.9%: 693 loggers in Washington and Oregon (Stibolt 1991)
  - 1.8%: 326 New Jersey residents (Anderson 1979)
  - 2.3%: 1212 patients at VA hospitals in NJ (Miller 1996)
  - 3.9%: cross-sectional 1060 US adults, workers included (Rogan 2002)

Asbestos Pleural Disease
Implications

- **Increased Risk of Malignancy**
  - lung cancer, mesothelioma!
- **Functional Impairment & Increased Symptoms**
  - Both circumscribed & diffuse disease
- **Progression**
  - Treating physician of Libby patients
    - 94/123 (76%) patients followed over time had significant decline in pulmonary function (Whitehouse, 2004)
  - Marysville Update 2005
    - Increase in observed x-ray abnormalities over 20 year period (from 5% to 25%)
  - Other studies show a 14%-30% increase in x-ray abnormalities 20+ years after exposure
  - 37% of amosite workers with < 1 month exposure had progression of interstitial & pleural disease 20 years after end of exposure (Erlich 1992)

Libby Non-Occupational Exposures
Historical & Present

- Family Contact With Workers
- Ambient Air
- Other
  - Playing in vermiculite piles
  - School areas (e.g., running tracks)
  - Home insulation
  - Garden use
  - Driveways
  - Popping on stove

Recent Exposures in Libby

- **Two Former Processing Areas** (areas in public use)
  - Contained LA up to 35% by PLM
  - Scenario testing indicated significant exposure & risk
- **Mine**
  - Highly covered with LA Bearing materials
  - Area regularly accessed until 2000
- **Mine Road**
  - LA contamination generates elevated airborne levels with traffic
- **Schools/Parks**
  - Mine tailings used at school tracks and city parks
- **Commercial/Residential Properties**
  - >40% have LA in yard, indoor dust or Vermiculite Attic Insulation (VAI)
- **Troy**
  - Initial Screening has indicated need for cleanup at ~ 20%

Historic Site Approach

- Use Removal Authority to do "Worst First" Cleanups
- Parallel Track the Development of a ROD Using Removal Data to Support an RI/FS and Baseline Risk Assessment (BRA)
- Maximize Number of Properties Cleaned Up per Year, While Minimizing Cost per Property

Worst First

- Former Processing Areas and Schools
- Areas Where Bulk Disposal Took Place
- Multiple Sources With High Levels
  - (e.g. yard >1% and >5,000 s/cm^2 and Zonolite present)
- Single Source With High Levels
  - (e.g. yard>1%, dust >10,000 s/cm^2)
- "Leaking" or "Disturbed" Zonolite Insulation

Current Removal Triggers

- Presence of VAI in Attic (not walls)
- Dust >5000 s/cm^2 in Living Areas
- LA >0.2% in Specific Use Area
  - Gardens, Flower Beds, Play Areas
- LA >1.0% in non-Specific Use Area
  - Yards, Fields

Cleanup Description

- Former Processing or Disposal Areas
  - Classic "Dig and Hauls"
  - Zonolite Mine Being Used for Disposal
  - Contaminated Equipment, Buildings, and/or Debris Either Cleaned or Disposed of As Needed
  - >500,000 yds^3 of Contaminated Soil Removed

Excavation at Screening Plant


KOMATSU

Disposal Area

Cleanup Description

- Residential/Commercial District
  - Bulk Soil/Source Removal First
  - Vermiculite Insulation Removal Second
  - Interior Cleaning Last
  - Clearance Using AHERA "Like" Protocol


CAUTION
CAUTION
04/20/2006

Typical Interior Removal Methods

- Remove VAI via Remote Vacuum System
  - Attic, Not Wall Space
- HEPA Vacuum Attic
- Seal Wall Space
- HEPA Vacuum/ Wet-Wipe Living Space
- Clear Property Via Aggressive Air Sampling - TEM Analysis

Vermiculite Attic Insulation (VAI)

Insulation made from Libby ore


276624
CAUTION
CAUTION
CAUTION
CAUTION
CAUTION
CAUTION
CAUTION
CAUTION
CAUTION
CAUTION
CAUTION


02/05/2003

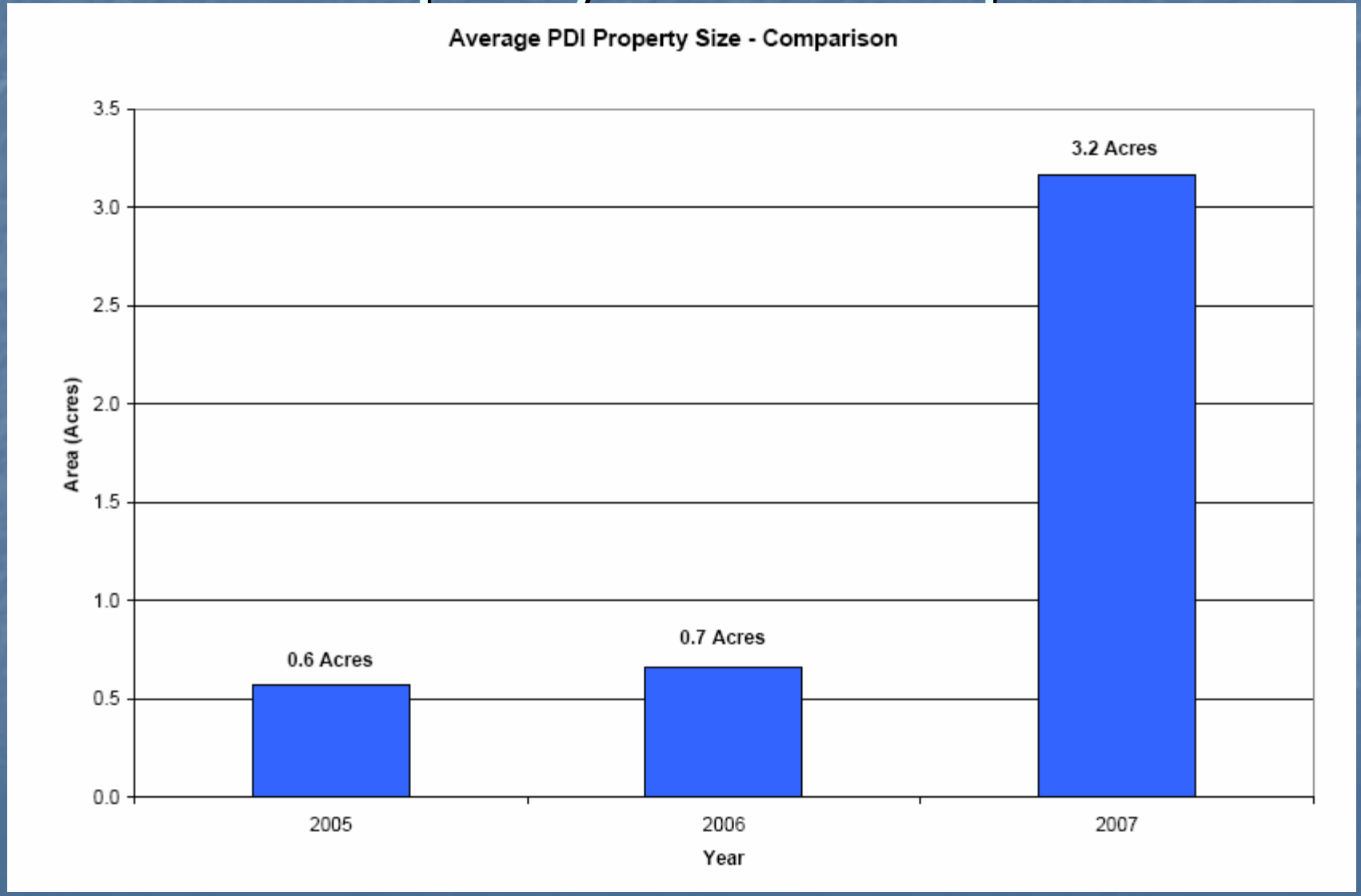
Current Situation - Cleanups

- Large Source Areas Effectively Done
- Approximately 1400 Properties in Libby Commercial/Residential Area Need Cleanup
  - How Many in Troy?
- At End of 2007, A Total of 954 Properties Have Been Completed
- Typical Residential Property Costs ~$55k Directly, ~$80k With Overhead

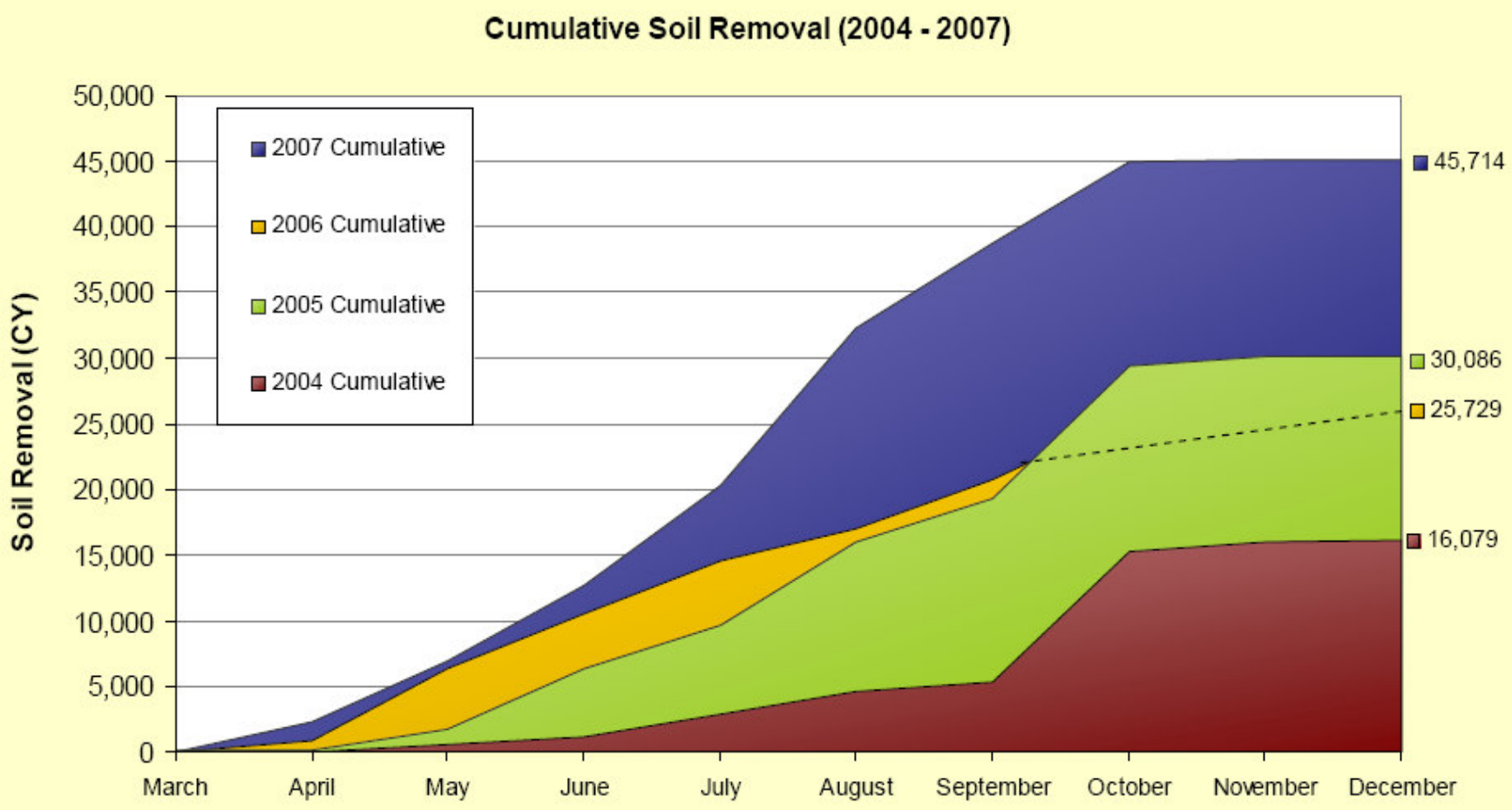
Current Issues - Cleanups

- Number of Properties Completed to Date Less Than Projected in 2003 (954 vs. 1231)
- More Properties in Libby Need Cleanup Than Identified in 2003 (1440 vs. 1231)
- Property Size is Getting Larger
- Property Cleanups Becoming More Complex
- Per Property Cleanup Costs Are Rising (~30%)

PDI Property Size Comparison



Cleanup Support – Volumes Removed



Current Issues - Technical

- Limited Understanding of Long-Term Efficacy of Current Removals (Only Historic Data Available for 4 of 753 Homes)
- Removal Data Insufficient to Support BRA (See Conceptual Site Model)
  - Insufficient quality & quantity, not representative
- Progress Frustrated by Sampling & Analytical Methods
- Current IRIS Risk Model Insufficient for Site
- RI Just Started for Mine and Troy in 2007

Current Issues - Technical Sampling & Analysis

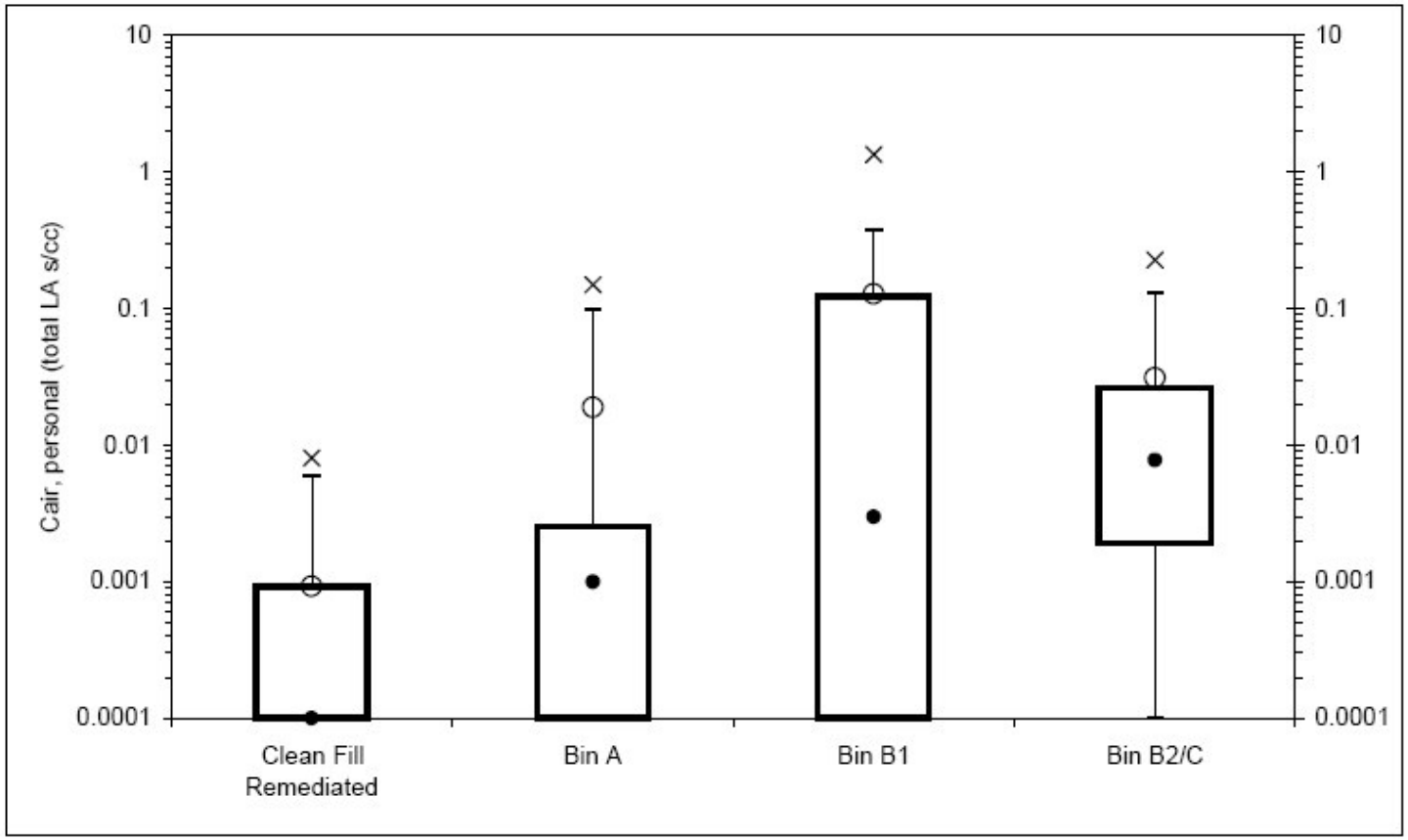
- Analytical sensitivity for air samples may not reach level of concern (e.g. past ambient air data)
- Bulk (PLM) Methods poor sensitivity (~0.2 by weight %)
- **Solid media** measurements (soil, ore, insulation, dust) cannot be converted to estimations of exposure & risk
  - Disturbance of contaminated media << 1% asbestos still generated high airborne exposures
  - **ND soils can generate high airborne exposures!**

Critical Exposure Data Issues

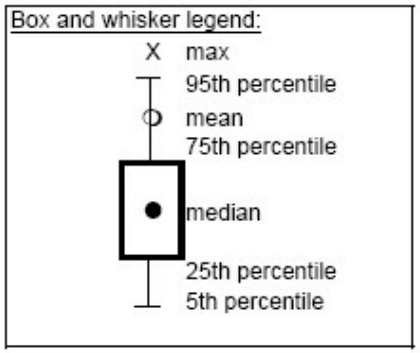
- Solid Matrix Sampling Insufficient for Clean Up Decisions
- The Completed Exposure Pathways in the CSM are not Properly Quantified
- Current Clean Up Efficacy has not Been Evaluated
- Nature and Extent Data are not Complete for the Mine and Troy (Traditional RI)

Solid Matrix Sampling

- Soils That are Non-Detect by PLM Still Generate Significant Airborne Fibers When Disturbed
- The Relationship Between LA Contamination of Indoor Dust to Indoor Air is Poorly Understood



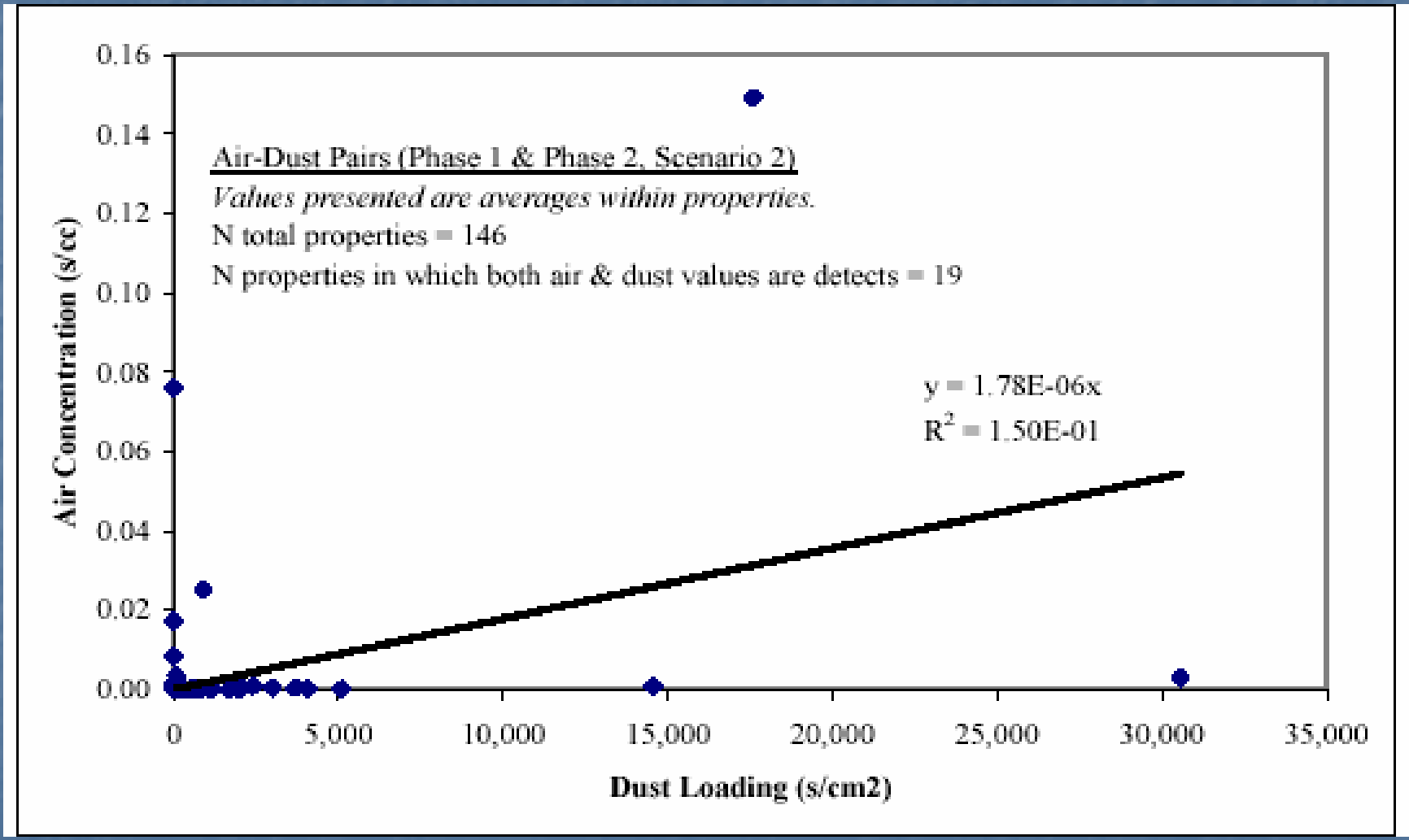
Non-detects are displayed at 0.0001 s/cc.



	Clean Fill (Remed)	Bin A	Bin B1	Bin B2/C
N samples	23	10	22	12
max	0.0081	0.15	1.3	0.23
mean	0.00092	0.019	0.13	0.031
95th percentile	0.0060	0.097	0.37	0.13
75th percentile	0.00093	0.0025	0.12	0.026
50th percentile	0	0.0010	0.0030	0.0077
25th percentile	0	0	0	0.0019
5th percentile	0	0	0	0

[Figure 7-7 in the SQAPP Summary Report.]

Indoor Dust to Indoor Air



Nature and Extent

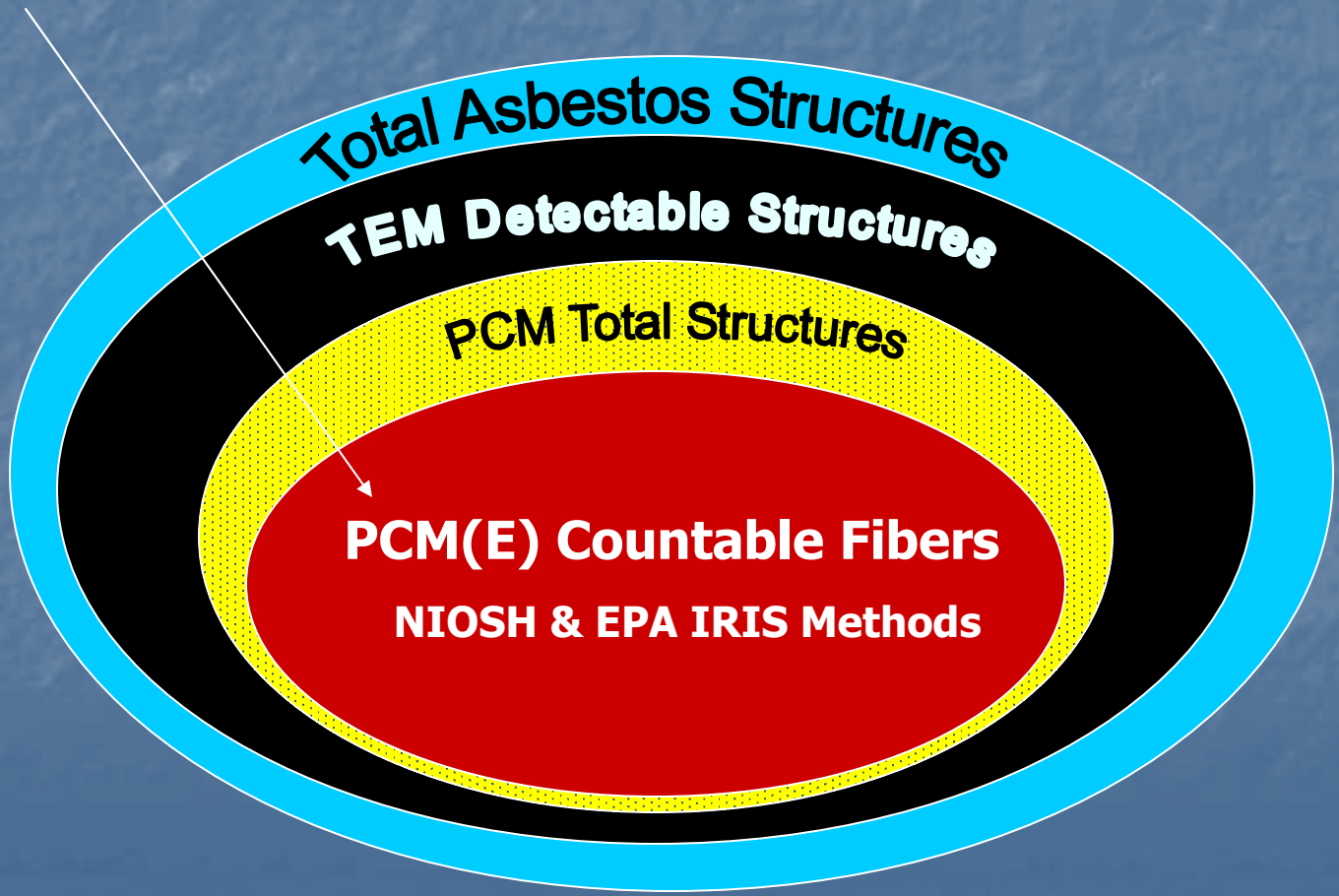
- Mine
  - Extent of Soil Contamination
  - Stream Transport
  - Airborne Transport
  - Surrounding Trees
  - Ecological Risk Assessment
- Troy
  - How Many Properties Impacted

Current Issue-EPA IRIS Risk Model Weaknesses

EPA Risk Assumption:	**What the Science Says:**
All fibers are chemically identical in terms of toxicity.	Amphiboles appear to be more potent with respect to mesothelioma (likely lung cancer & lung fibrosis).
Shape/Morphology does not influence fiber toxicity.	*In vivo* and *in vitro* toxicity studies demonstrate strong influence of fiber width and length on toxicity.
PCM fibers adequate surrogate of exposure to use for risk assessment.	Fibers not counted by PCM are toxic (i.e. shorter and thinner fibers likely contribute to risk).
Non-cancer risks from fiber exposure are not significant for residential exposures.	Non-cancer bio-changes affect >18% of Libby population. Non-cancer risks may be new driver.

Asbestos Fiber Detection & Counting
TEM versus PCM

- **IRIS Definition: Phase Contrast Microscopy (PCM)**
  - Length (>5 µm), Width (>0.25 µm), Aspect Ratio (Length:Width Ratio > 3:1)



More Current Issues

- Congressional Pressure
- Community Unease
- OIG Investigation (See Letter)
  - Use of Science
  - Community Input
  - ROD(s)

Proposed Approach

- Reorganized Site Attack
  - Mine (Bonnie Lavelle)
  - Former Processing Areas (Kathryn Hernandez)
  - Libby Commercial/Residential District (Paul Peronard)
  - Troy (Catherine LeCours; Kathryn Hernandez)
- Invest in Fundamental RI and Initiate Scientific Investigations in FY 2007
  - On-Site Exposure Assessment
  - Libby Action Plan (LAP)

Combined CSM/Efficacy Sampling

- The "Big Three" Pathways
  - Outdoor Ambient Air
  - Indoor Air (ABS)
  - Outdoor Air Around LA Contaminated Soils (ABS)
- Transportation Corridors
- The Rest

Proposed Approach

- Update RA Fund Request to Priority Panel to Reflect Current Situation
  - Request for Troy Denied in 2007

Adjust Current Cleanup Strategy
  - Remove All Visible Vermiculite

- Increase Regional Pipeline Commitment to Facilitate Technical Projects
  - 2006: $1M
  - 2007: $2.85M + $4.49M in deobs
  - 2008: $6.25M

Find Additional Pipeline Funding to Supplement Regional Budget

Future Topics

- Budget, Money, Budget, Money
- Grace Settlement
- The Making of A Site Specific Risk Assessment
- LAP Progress
- Action Memorandum Amendment #6
- The Inspector General